

## **Development of Deterioration Factors for Small Off-Road Engines**

The Small Off-Road Engine (SORE) regulations, Title 13 of the California Code of Regulations, Section 2403 (13 CCR 2403) require that emission deterioration factors (DFs) be developed for engine families certified to a durability period beginning with the 2000 model year. The purpose of this document is to summarize the SORE DF guidance documents previously published and to clarify DF carry across and carry over provisions.

1. 13 CCR, SORE Test Procedures, Section II.3 – States how the manufacturer must determine the DF based upon the emission durability period selected.
2. Mail-Out MSO 99-08, Attachment A - Provides guidance on the test cycles, service accumulation methods, test procedures, and the methodology to calculate DFs and certification emission levels.
3. ARB Correspondence to the Portable Power Equipment Manufacturers Association (PPEMA) Reference C-2000-343 - Lists alternate service accumulation cycles ARB will accept for engines with displacements less than 65 cubic centimeters; when confirmatory testing is required; and states that similar engine and emission control designs and emission characteristics may be grouped for durability demonstration purposes.
4. Title 40, Code of Federal Regulations, Section 90.104 (g)(1) – Provides a method for calculation of Assigned DFs that may only be used by Small Volume Manufacturers (manufacturers with an total annual California production of less than 500 engines (SORE Test Procedures, Part II (3)(b)).
5. DF Carry across - The manufacturer must receive prior ARB approval in order to carry across durability data from one engine family to another. Therefore, manufacturers should submit requests for carry across of DFs early in the certification process in order to avoid delays in the issuance of Executive Orders (EOs). Carry across of DFs will only be allowed from the worst case engine family to another engine family with the same or better emissions over its useful life. The manufacturer must provide the following in support of the carry across request:
  - (a) An engineering evaluation describing why the in-use emission characteristics of the two engines are expected to be similar. The evaluation should include, but is not limited to, the following factors:
    - I. Emission Control Systems (ECS)
    - II. Fueling systems (carburetor or fuel injection)
    - III. Equipment applications

- IV. Standards and test cycles
- V. Displacements (within 15% of total displacement)
- VI. Engine cooling medium (air or water)
- VII. Method of air aspiration
- VIII. Cylinder block configuration (single cylinder, inline, etc.)
- IX. Combustion cycle
- X. Heat load on the engine
- XI. Engine Deposits
- XII. Bore and stroke ratio
- XIII. Brake specific fuel consumption

- (b) Test data supporting the engineering evaluation
- (c) Technical diagrams of the engines
- (d) Any other information that would be relevant to determining the appropriateness of the carry across request

Carry across approval will be granted when the manufacturer has demonstrated to the ARB staff's satisfaction, based on this information, that the DF is representative of the durability characteristics of the engine family to which it is intended to apply.

- 6. DF Carry over -Typically, ARB will allow the carry over of DFs from one model year to the next provided that there has been no substantive changes to the engine family. Any change to the engine family such as engine design, emission control system, or change in the certification standard or emission durability period will require the manufacturer to generate a new DF. Please note that it is the manufacturer's responsibility to ensure that DFs are representative and accurate.